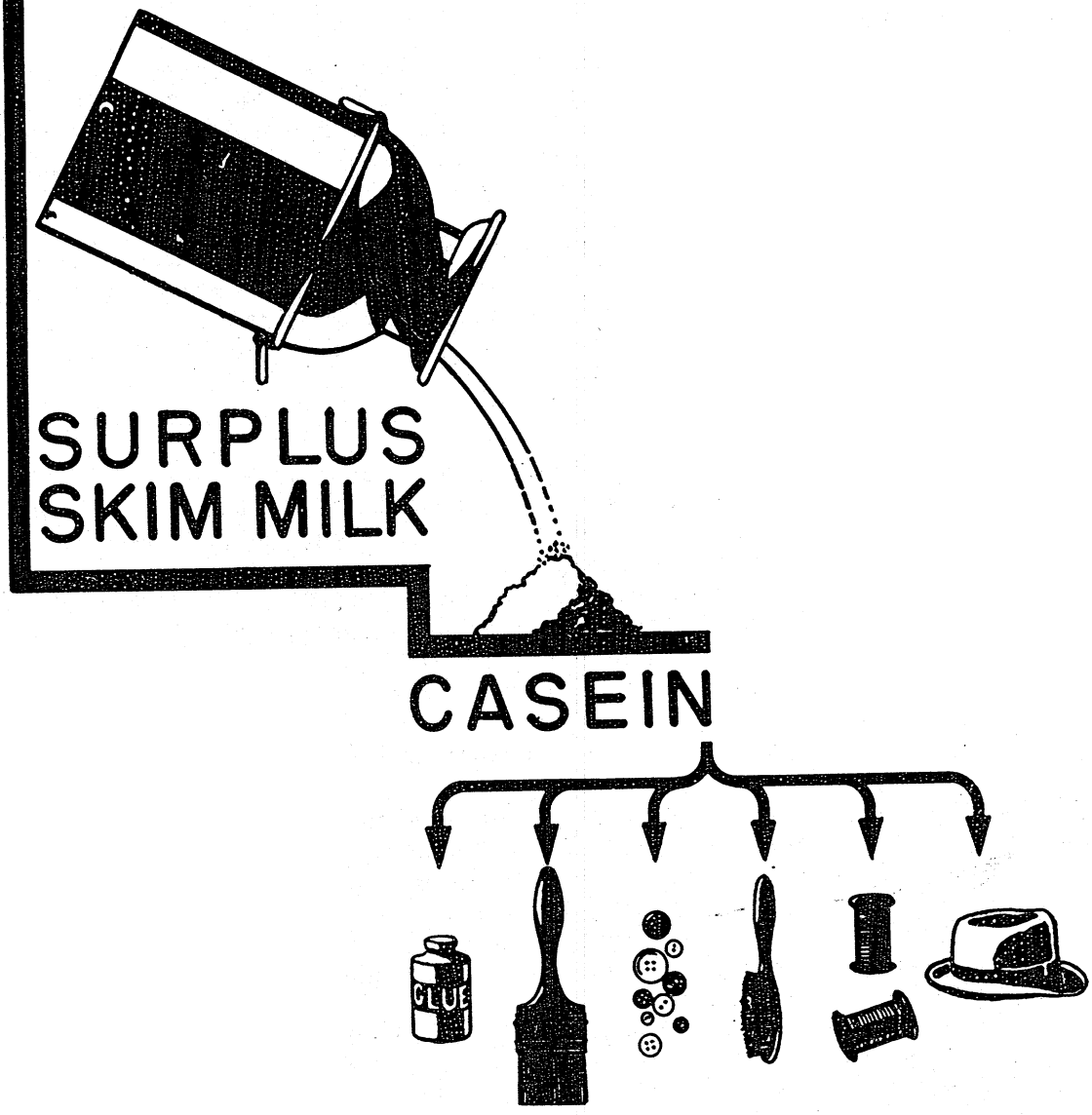
NOVEMBER 1945 AIC-107

MAKING CASEIN

ON THE FARM
FOR INDUSTRIAL USE



EASTERN REGIONAL RESEARCH LABORATORY, PHILADELPHIA, PA.

MAKING CASEIN ON THE FARM FOR INDUSTRIAL USE

R. C. Warner, T. L. McMeekin and R. W. Jackson

Eastern Regional Research Laboratory
Philadelphia 18, Pennsylvania

Bureau of Agricultu al and Industrial Chem'stry
Agricultural Research Administration
United States Department of Agriculture

INTRODUCTION

Many farmers find it financially advantageous to separate cream on the farm for sale to creameries and for retail sale. In 1942, 31,900,000,000 pounds, or 26 percent of all the milk produced in the United States, was separated on the farm. Most of the skim milk as well as buttermilk so produced is utilized as animal feed. Since the removal of casein from skim milk is not complicated, the production of casein on the farm may possibly become an additional source of farm income. Making casein on the farm requires more experience and time than does the separation of cream, though the method described in this circular is essentially simple. Since the whey left after the removal of the casein contains practically all the milk sugar, mineral salts, and vitamins of skim milk, as well as one-fifth the protein, it is a valuable animal feed.

Whether or not it is practical to make casein on the farm will depend on the amount of skim milk available and relative returns that can be obtained from different uses, such as direct sale, for feed, or for casein. Production of casein will probably be more advantageous in those parts of the country that produce relatively large quantities of skim milk and on farms with 10 or more milk cows. It may be advantageous to make casein at certain seasons of the year, for example, at the peak of milk production in early summer, rather than at other times

Casein and Its Uses

Skim milk contains about 3 percent of casein by weight. When skim milk sours, the casein separates from the whey and settles to the bottom of the container. Cottage cheese is really a kind of casein made by souring skim milk and adding rennet or junket tablets. The method of preparing casein and the uses herein described, however, must not be confused with those pertaining to cottage cheese and other kinds of cheese.

Casein finds wide commercial use as an adhesive in coatings for book and lithographic papers, in water paints, in cold glue for veneering and joining wood, in insecticides, and in artificial fiber resembling wool. Approximately 50 million pounds of casein are now used in this country annually for nonfood purposes, of which about one-fifth is normally imported.

Kind of Milk to Use

It is best to utilize the skim milk as soon as is practical after separating the cream, before souring takes place. It will be convenient to start the preparation of casein in the morning. Skim milk obtained the previous evening and that obtained from the morning milking may then be combined. While it is possible to prepare casein from naturally soured skim milk (or from buttermilk), the following method involving the use of sulfuric acid is more advantageous. It is necessary to remove the cream effectively by means of a good cream separator before making casein, not only because cream is the most saleable portion of milk but also because the presence of butterfat in casein is undesirable.

Equipment and Supplies

The method of making casein described here is based on a unit handling about 45 gallons of skim milk a day, but can easily be adapted for multiples of this unit to handle larger volumes. It is equally suitable for making casein in small dairies. When 1,000 or more gallons of skim milk is to be processed daily, the methods and equipment described in United States Department of Agriculture Circular No. 279 should be consulted.

The equipment required for making casein is largely wooden and can be assembled or constructed with a small amount of labor. The following equipment is recommended, though other available equipment may be substituted.

ONE 50-GALLON WOODEN BARREL

FIVE SMALL WOODEN SPIGOTS)
ONE LARGE WOODEN SPIGOT (1 INCH INTERNAL DIAMETER))

OR

(ONE PIECE OF 5/8-INCH GARDEN HOSE
(8 TO 10 FEET LONG
(ONE SMALL FAUCET FOR END OF HOSE
(ONE C-CLAMP
(ONE BUCKET FOR DIPPING CURD OUT OF
(BARREL

ONE WOODEN PADDLE
ONE 1-QUART GLASS MEASURING PITCHER FOR MEASURING ACID
ONE THERMOMETER READING UP TO 120° F
ONE 6-GALLON EARTHENWARE CROCK FOR HOLDING ACID
EIGHT 1/2-BUSHEL UNBLEACHED MUSLIN BAGS FOR PRESSING
TWO PRESSES
WOODEN TROUGH FOR CATCHING DRIPPINGS FROM BAGS
ONE DRIER
TWENTY-ONE YARDS OF 32-INCH COTTON BAGGING FOR COVERING TRAYS
ONE ELECTRIC FAN
SACKS FOR STORING DRIED CASEIN
SIX 2-QUART BOTTLES OF 33.5-PERCENT SULFURIC ACID WITH A SPECIFIC GRAVITY OF 1.247

Precipitating barrel.-- A 50-gallon wooden barrel is drilled at 5 places on the side and fitted with wooden spigots as shown in Figure 1. A large spigot[1] (at least 1 inch in internal diameter) is installed flush with the bottom of the barrel. The small spigots are used for draining off the whey and wash water after the curd has settled; the large spigot is used for removing the washed curd. The barrel should stand on a small platform about 2 feet above the ground.

A barrel with no spigots may also be used. In this case the whey and wash water are removed by siphoning, and the curd is dipped out with a bucket. A simple siphon constructed from a piece of garden hose with a faucet or cork at the outer end is attached to the barrel as shown in Figure 1. To start the siphon, a stream of water is run through it, and the outer end is closed. To siphon out the whey, the outer end of the hose, which must be lower than the level of liquid in the barrel, is opened. As the level of whey in the barrel becomes lower, the position of the siphon is shifted until the end in the barrel is just above the settled curd. The siphon is stopped just before it begins to suck air so that it will not have to be refilled with water before being used again.

Press.--The construction and use of a suitable press are shown in Figure 2. Two units of the kind shown are necessary to handle 45 gallons of milk.

Drier.--The drier is illustrated in Figure 3. The trays are constructed of cloth stretched over the rectangular frame shown in the figure. Lightweight cotton bagging is the best material to use, but other types of cotton cloth are satisfactory. The drier holds two of these trays at each level. The vanes for distributing the air to the different levels can be made of heavy cardboard tacked to light wooden frames if plywood is not available. A large fan, about 16 inches in diameter, is required for circulating the air. The circular opening at the end of the drier and the shelf on brackets are made to fit the particular fan to be used.

One side of the drier is closed by tacking heavy cardboard over it. When the drier is in use, the other side is closed by a wooden frame covered with cardboard. This frame must be easily removable so that the trays can be put in the drier or taken out.

Dilution of the Sulfuric Acid.--The sulfuric acid in a concentration of 33.5 percent can be purchased in 2-quart bottles. This must be diluted with water to ten times its volume. Make a mark on a 6-gallon earthenware crock at the level to which it will be filled by 5 gallons of liquid. Fill the crock about halfway to this mark with water. Pour one bottle (2 quarts) of the acid into the water. Fill the crock to the 5-gallon level with water and mix with a wooden paddle. Make all measurements as carefully as possible and avoid spilling any of the acid. Special care should be taken to keep the acid from the skin and clothing, as burns may result from contact with the acid. If acid is spilled, rinse or flush with a solution of bicarbonate of soda.

[1] THE LARGE SPIGOT MAY BE DIFFICULT TO PURCHASE OR IMPRACTICAL TO CONSTRUCT WITH TOOLS AT HAND. IF SO AN EXTENDED OUTLET FROM THE BARREL MAY BE MADE FROM WOOD AND CLOSED AT THE OUTER END WITH A STOPPER. THE INTERNAL DIAMETER OF THIS OUTLET SHOULD BE NOT LESS THAN 1 INCH.

Coagulation of Casein

The precipitating barrel (Figure 1) is nearly filled with 45 gallons of fresh skim milk which should be at a temperature between 68° and 86° F. Coagulation of the casein should not be attempted with milk at a lower temperature than 68° F. As the diluted acid is used in the proportion of one cup (1/2 pint) to a gallon of skim milk, this amount of milk (45 gallons) will require 11-1/4 quarts. Nearly two thirds of this quantity, 7-1/4 quarts, is measured out and poured slowly into the milk which is stirred well with a wooden paddle. The remainder of the acid is added one quart at a time, with just enough gentle stirring to mix the acid and the milk. If the stirring is too vigorous, the curd will be finely divided and will not settle well. The milk is allowed to stand for 2 or 3 minutes between each addition of acid. The curd should separate in a granular form just before the last quart of acid is added. After all the acid has been added, the milk is stirred gently for a minute or two.

The amount of acid mentioned above should give the correct acidity for 45 gallons of almost any milk but milk from Jersey cows may require extra acid. There should be no separation of the curd after the first 7-1/4 quarts of acid have been added. A few small clumps of casein may be noted, but if a clear greenish-yellow whey separates at this point, it is an indication that the milk had started to sour and consequently was already somewhat acid. If the milk has partly soured, only sufficient acid should be added to give a separation of the clear whey, and then one pint more of acid should be added.

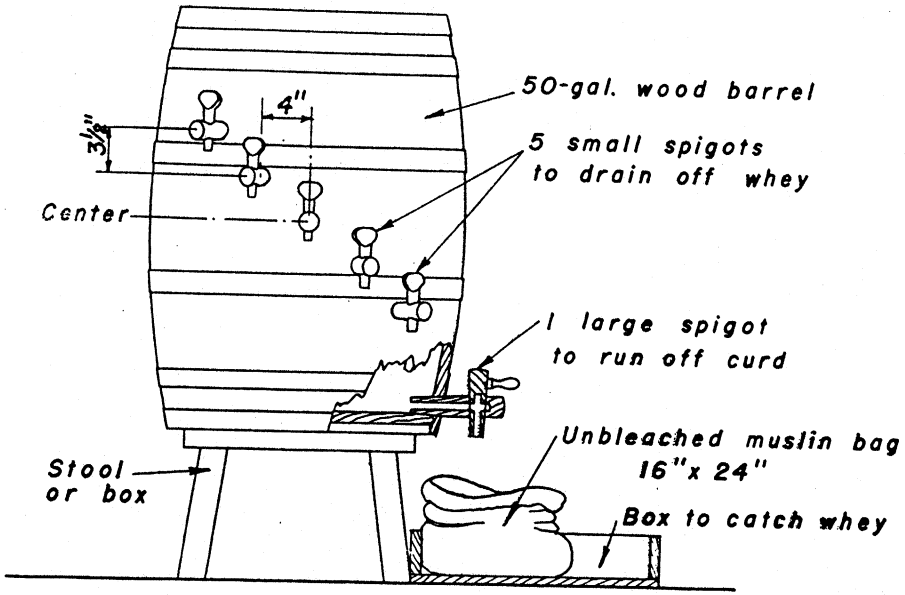
If an amount of milk other than 45 gallons is used, the amount of acid required can be calculated on the basis of 1 quart for 4 gallons of milk. This is equivalent to 1 measuring cup (1/2 pint) of acid for each gallon of milk.

Removing the Whey

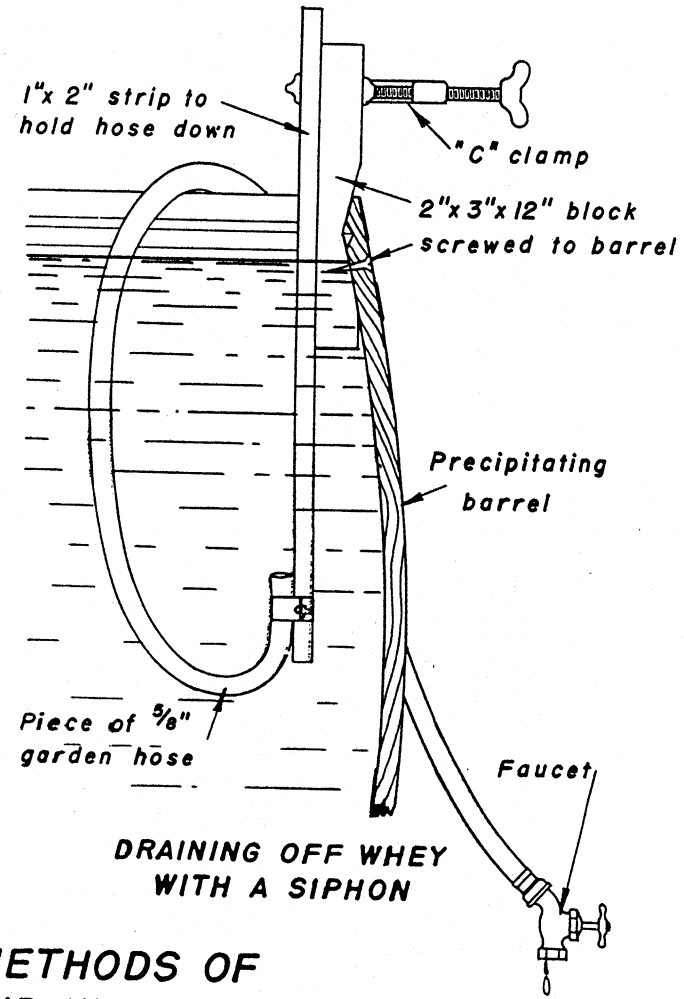
In about half an hour the curd will have settled to the lower half of the barrel. The whey is then removed by opening one of the spigots in the side of the barrel, or by use of the siphon, and collected in a barrel for use as an animal feed. As the whey drains off, it should be allowed to pass through one of the cloth filtration bags to catch any small particles of curd. The whey is drained off as close as possible to the mass of curd.

The curd is then washed by filling the barrel with clear water and stirring gently to mix the curd and the remaining whey with the water. The curd is allowed to settle again, and the wash water is removed in the same manner as the whey was removed. At each settling of the curd, at least half the total volume of whey or wash water should be removed. This washing operation is repeated twice (three washings in all). The number of washings cannot be reduced without producing an inferior grade of casein.

Slightly more than half the total whey is obtained upon the first settling of the casein. The first wash water contains a quarter more and, if desired, may be collected and added to the undiluted whey. The second and third wash waters are discarded, since their nutritive value is low.



PRECIPITATING BARREL WITH
SPIGOTS FOR DRAINING



DRAINING OFF WHEY
WITH A SIPHON

FIGURE I.– ALTERNATE METHODS OF
SEPARATING CURD AND WHEY

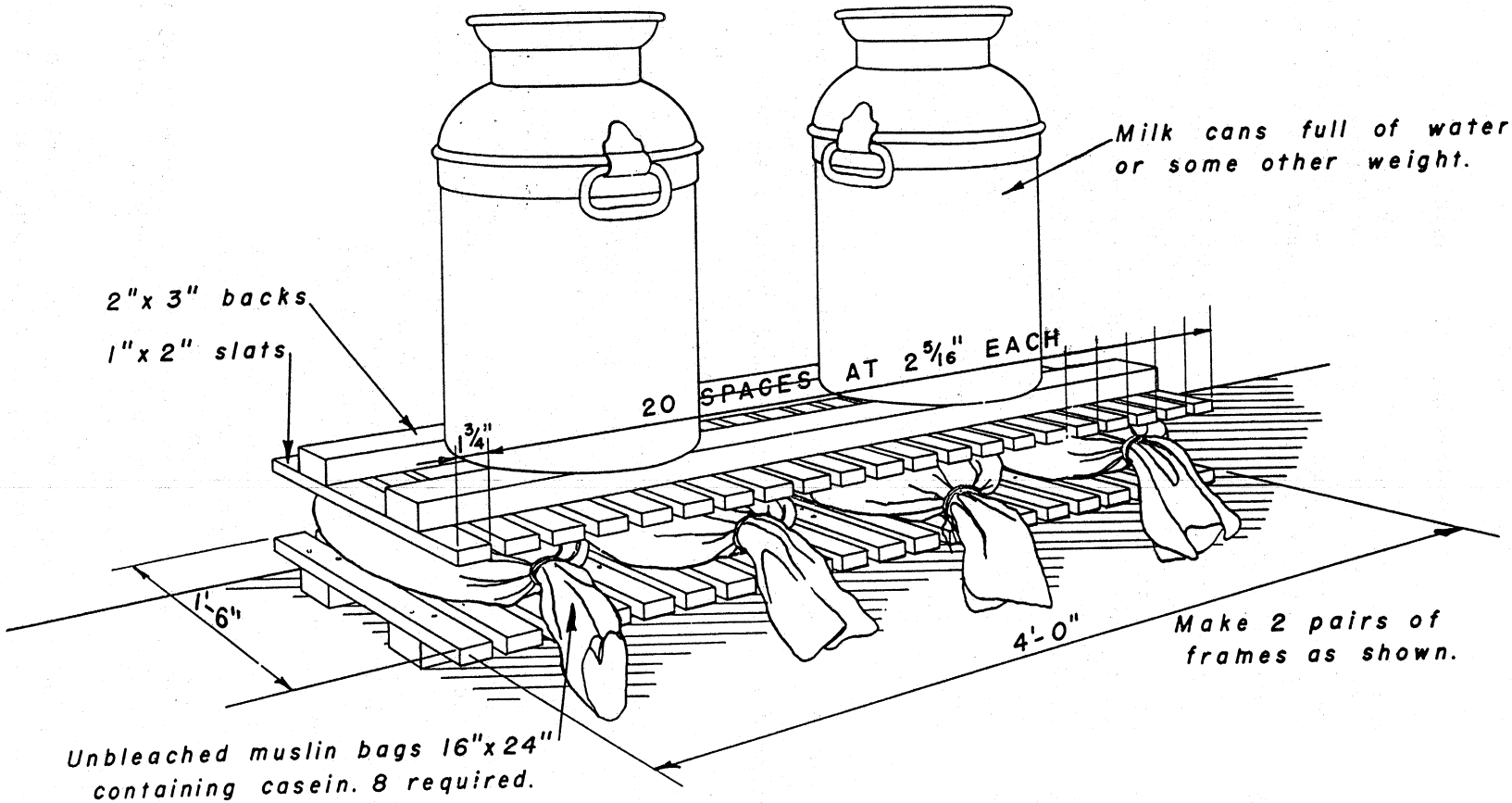


FIGURE 2.— PRESSING OUT EXCESS WHEY

Filtering and Pressing

After the last washing is completed, the curd and the remaining wash water are removed through the large spigot at the bottom of the barrel. If a barrel without a spigot is used, the curd is dipped out with a bucket. In either case the last part of the curd is removed by tipping the barrel and washing it out with water.

The curd is run or poured into eight cloth bags (1/2-bushel size). Each bag in turn is placed in a bucket or wooden trough, and the curd is poured into the bag until it is two-thirds full. It is then tied at the top with a short piece of rope and hung on a peg on the wall or on any suitable rack to drain. Provision should be made for a trough to catch the drippings. Most of the excess water will have drained off in about an hour. The bags are then tied with heavy cord as close to the mass of curd as possible and put in the press. Four bags can be put in a press of the size described. Two 10-gallon milk cans filled with water are then placed on top of the press. The pressing should continue for about 3 hours. The bags are then opened, and the curd, which will be in the form of a firm cake, can easily be removed.

After the cloth bags have been used, they should be washed and then boiled in water to which a little washing soda has been added. This is necessary to prevent the formation of mold, which might contaminate the casein.

Drying

After the cake of curd is removed from the pressing bag, it is crumbled by hand and spread out on the trays of the drier. One tray is used for each bag of curd. The trays are placed in the drier, and the fan is started. The casein should be dry in 24 to 48 hours depending on the temperature and humidity. After the drier has been in operation from 12 to 16 hours, the trays should be removed and the casein mixed with a large spoon or a dull knife. Since the drier described has 20 trays, it will take care of the casein from 90 gallons of milk, so that 45 gallons a day can be processed even if 48 hours are required for drying. The casein is dry when the particles are hard and slightly yellow. Any large pieces should be broken open to make sure there is no undried casein in the center. The casein must be completely dry when it is removed from the trays.

It is possible to dry the casein satisfactorily in the sun in good drying weather. The curd is spread on the trays, and these are supported on any suitable frame or stand in the direct sunlight in such a way that air circulates freely above and below each tray. Casein will dry under these conditions in about 10 hours. This method of drying is very satisfactory, but it is dependent on good drying weather.

The wet pressed curd can be kept for about 24 hours before drying if conditions are such that it will dry rapidly when placed on the trays. It is better, however, if the drying can be started as soon as the pressing is completed.

Storing and Marketing

The dry casein should be sacked and stored in a dry place off the ground or concrete floor and away from rats and other vermin. It is not advisable to store the casein longer than about a month. When 100 pounds have been accumulated it should be marketed. Before the preparation of casein is undertaken, the prospective buyer should, of course, be contacted.

The price of casein varies considerably; it has fluctuated from 10 to 30 cents a pound in recent years but in normal times the range is 10 to 16 cents. In August, 1943, the price for a good grade of casein was 23 cents a pound. Of this, about 3 cents a pound represented the cost of grinding and other handling after the unground product was received by the manufacturer. Good prices are paid only for high-grade casein which has been washed well during its preparation and is clean and free from dirt.

Forty-five gallons of milk will yield 10 pounds of casein. The manufacture of this amount of casein a day is an operation that can be fitted into other work on the farm. It will, however, require about 4 hours a day for one person. Precipitating and washing the curd and placing it in bags for draining is a continuous operation requiring about 2 hours. The other work, such as placing the bags in the press and spreading the pressed curd on the drier trays, can be done whenever convenient and should take about 2 hours altogether.

It would be highly advantageous for several farmers to pool their excess skim milk and make casein on a cooperative basis. By this means the time or cost of making casein can be materially reduced.

Use of Whey as Animal Food

The whey left after the removal of casein is a valuable animal food that contains all the sugar and most of the salts and vitamins of skim milk and approximately one-half the solid material of whole milk. It also contains 0.8 percent protein. Before this whey is fed to animals, the acidity should be neutralized by the addition of one cup (1/2 pint) of bicarbonate of soda for each 10 gallons of whey. The bicarbonate of soda should be added cautiously, with stirring, to prevent loss of whey because of foaming. Whey can be best utilized when fed with solid feed, such as ground grain.

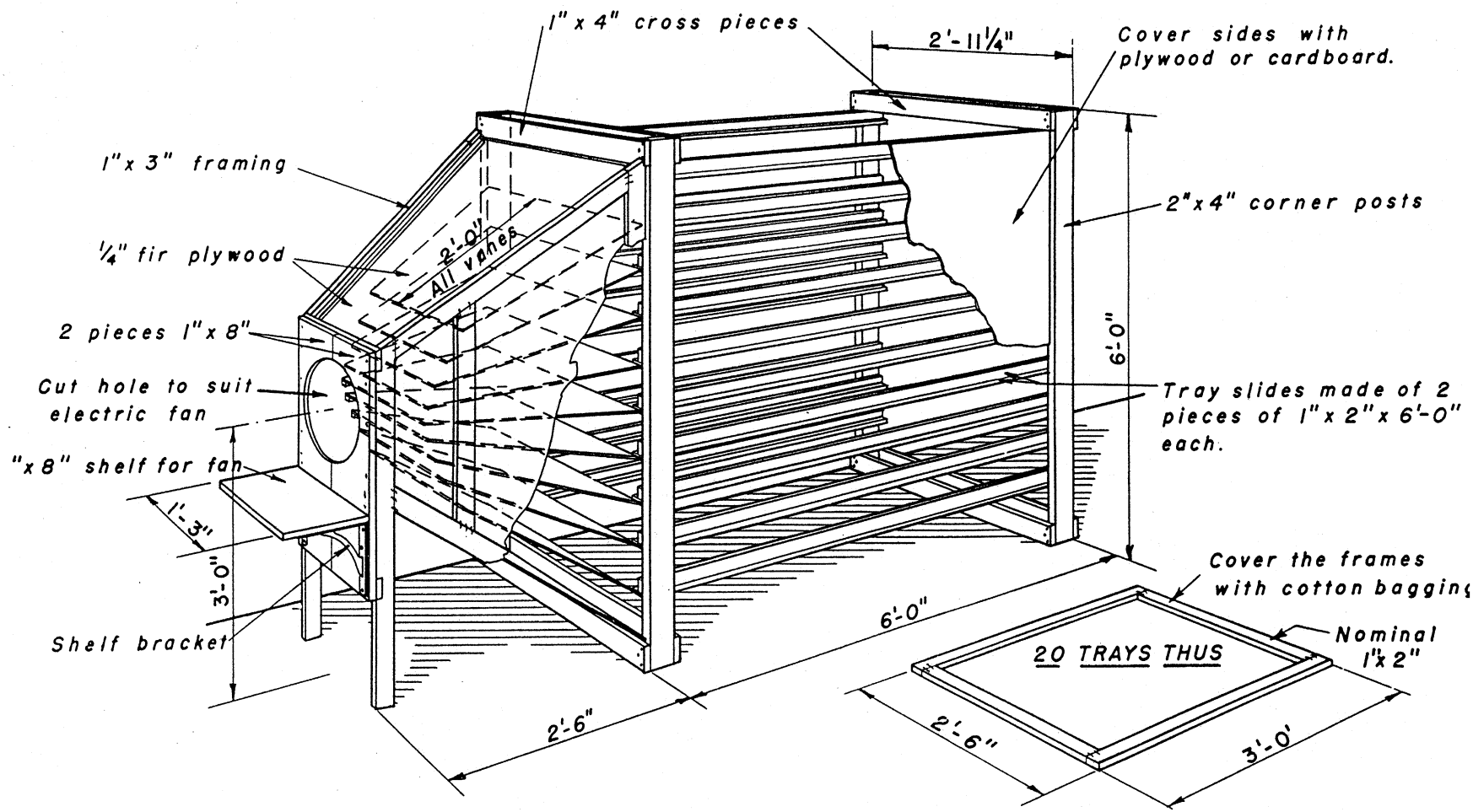


FIGURE 3.- DRYING RACK AND TRAYS